How important is the proper ground?

Nick Liberto, P.E.  Powder Coating Consultants

To accurately answer this question we should first examine how the electrostatic application of powder coating works. Powder coating particles are electrostatically charged by frictional charging (tribo charge) or by passing through an electrostatic field produced by an electrostatic generator (corona charge). Since the powder particles are not conductive, they will store the electrostatic charge. The powder particles are then attracted to a grounded surface by electrostatic forces created by the stored electrostatic charge. Without a properly grounded surface available to attract them, these powder particles will be drawn into the powder recovery system. This brings us to the next question.

What production problems are caused by a poor ground?

Inconsistent and inadequate coating. Most often, it is only a particular section of a coating line, such as a hanger, that is not properly grounded. The result is that one part in a series of parts will not be coated as evenly as the others. In addition, when the ground on a part is poor, inadequate coating in Faraday cage areas may be more pronounced. If the part grounding is poor throughout the entire coating area, then all the parts will be inadequately coated.

Poor transfer efficiency. Transfer efficiency is a measure of how much of the powder that is sprayed ends up on the parts that are being coated. The previous discussion of how electrostatic application of powder coating works explains why an improperly grounded part results in poor transfer efficiency: If a high percentage of the electrostatically charged powder particles do not have a grounded surface to be attracted to, then the only place they can go is into the powder recovery system. In such situations transfer efficiency will be low.

Inadequate film thickness. This can be a problem in operations that require film builds greater than 2 mils. In this situation if a part is improperly grounded, its surface will lose its ground after the part has received a certain amount of coating. The surface will have the same charge that the powder particles have and reject additional powder particles that are sprayed on it. Called back ionization, this phenomenon slows or eliminates the buildup of powder on the part surface and accounts for the failure of the part to attain the specified coating thickness.

In addition to causing production problems, inadequate grounding also creates unsafe working conditions.

What safety problems are caused by poor grounding?

All equipment and devices in the powder coating area must be properly grounded for safe operation. This is because, like ungrounded powder particles, ungrounded equipment and devices will store an electrostatic charge when they are subjected to an electrostatic field. When the charge reaches a sufficient level, the charged article will discharge this energy to ground, causing an arc or spark. If the arc or spark occurs in an area that contains the right fuel-to-air mixture, it becomes a source of ignition that creates a fire. Fire releases a tremendous amount of energy; if confined, such as in some recovery systems, it creates an explosion.

Following are pieces of equipment and devices in a powder coating system that will typically store an electrostatic charge. They must therefore be grounded properly.

- The parts that are being coated
- The spray booth
- The recovery equipment
- The spray equipment
- The gun motion equipment
- The ductwork, if any
- The feed hopper
- The operators and manual spray personnel
- The conveyor and part hooks

What is a proper ground?

The National Fire Protection Association (NFPA) states in its bulletin number 33, chapter 13, paragraph 13-4c. "To minimize the possibility of
ignition by static electrical sparks, powder transportation, application, recovery equipment, work pieces, and all other conductive objects shall be grounded with a resistance to ground not exceeding 1 megohm." This is the definition of a proper ground.

An uncoated metal part, clean hanger, and clean conveyor have little resistance to ground since they are excellent electrical conductors. What degrades this ideal path to ground is powder buildup on the contact points of the hanger and conveyor. Swivel assemblies on the conveyor, as well as dirt and contaminants, will also impede the path to ground. According to NFPA standards, all of these sources, in total, must not exceed 1 megohm (1 million ohms) resistance to ground.

**How do you measure proper ground?**

The device that is used to measure continuity to ground is an ohm meter that has a megohm scale. This device can be a volt-ohm meter (VOM) or a Megger. The VOM typically uses a low-voltage power source (9 volts) to check resistance. This is adequate for checking electrical circuits but, because of its low voltage, is not well suited for checking proper ground in a powder coating system. The Megger, which was originally designed to check motor windings, is the better device because its power source is typically 500 volts or higher. This provides the current required to measure the resistance to ground in a powder coating system.

To check resistance to ground, extremely long test leads are used to connect one end of the meter to a known building ground and the other end to the part to be coated. The use of long leads allows the resistance to ground to be measured through the entire coating area (powder booth). By hooking the meter to the known building ground and the part, all the devices in between (that is, the hangers, conveyor, swivels, and all other devices) are included in the test circuit, and their resistance to proper ground can be measured and read from the scale on the meter.

If the resistance exceeds 1 megohm, then use the leads to hook one end of the meter to a known building ground and the other end to the hanger contact point. If resistance still exceeds 1 megohm, repeat the meter-connection procedure with the device next closest to the part (the swivel or conveyor hook) until the resistance is measured in the proper range. By starting at the part and working backward, you can determine which device needs corrective action to improve the ground. Now that you have determined which device needs to be worked on, the next question will come to mind.

**How do I improve my ground?**

If your metal parts are uncoated and you hang them from conductive points, they will not impede proper ground transmission. Therefore, the next device that should be examined for excessive resistance to ground is the hook or hanger that holds the part on the conveyor line. The most important parts of the hanger are the contact points (on both the part and conveyor). If these contact points are clean, the hanger will conduct the proper ground—even if the rest of the hanger is coated with powder.

Hanger maintenance offers several choices. You can choose to clean the contact points only or the entire hanger. If you choose to clean the entire hanger, you can burn it clean, chemically strip it, sandblast it, or mechanically break the coating off it. (In the next issue, this column will discuss hanger maintenance detail.)

If the hanger contact points are clean and the hanger conducts proper ground, then the next items to be examined are any swivel or indexing devices that are used to rotate the part. These often pose a problem for good continuity to ground. If they do in your system, clean them with an approved solvent.

After the swivel or indexing devices have been checked and cleaned, the conveyor itself should be checked, starting with the conveyor ground. If the conveyor shows a resistance to ground that exceeds the recommended limit, a new ground should be provided in the area of the coating booth. This will require wiring the conveyor rail to a known building ground at this area.

If after this is done, the resistance to ground is still too high, then examine the conveyor wheels and chain for cleanliness to ensure that they provide good contact points. These components of the conveyor must be free of powder buildup to conduct a proper ground. If they need cleaning or replacement, consult the conveyor manufacturer for the proper procedure.

If all the conveyor components, including swivel or indexing devices, have been checked and cleaned and still present resistance to ground that exceeds the recommended limit, then a grounding bar may be required. Available as a bar or a brush-type device, the grounding bar is designed to conduct a proper ground directly to the part hanger. To conduct a proper ground, it must be connected to a known building ground and be in contact with a clean part hanger.

Though a grounding bar can solve grounding problems, it can create other problems in the powder coating system: It can be noisy, drop metal shavings into the booth, provide an impedance during color change, and create a trap for dirt and contaminants.

Though the time spent discovering the component or components of the coating system that provide resistance to ground can be considerable, it is time well spent. Poor grounding affects the entire powder coating operation and compromises worker and plant safety. For these reasons, the importance of a proper ground cannot be overstated.

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